GOVERNMENT OF INDIA.

REVENUE AND AGRICULTURAL DEPARTMENT.

WEATHER SUMMARY FOR JULY 1889.

The 26th August 1889.

General Weather conditions of the month.—The south-west monsoon current is usually fully established before the end of the month of June, and generally prevails with great steadiness during the whole of July. It is hence a month of frequent, and in some districts of almost constant, rainfall and of comparative uniformity of temperature and great humidity over the greater part of the country. The only area in which the rainfall is small in amount and hot weather conditions continue to prevail are Sind, North-West Rajputana, and the West Punjab.

The distribution of rainfall during the month depends largely upon the relative strengths of the two branches of the monsoon current. The Bombay branch advances usually in an easterly direction across the Peninsula, and in a north-easterly direction across Central India and Rajputana towards the Punjab. The Bay of Bengal branch of the current, which is at the head of the Bay of less volume and extent than the Bombay branch when it enters India, is deflected westwards up the Gangetic Valley and is strongest near the hills. Between the two areas in which these currents exclusively prevail is a long trough-like belt of country which forms a kind of debatable ground in which there is much interaction between the currents. This is one of the most conspicuous features of the meteorology of the month. In this belt pressure is somewhat lower than it is either to north or south, so that it forms a trough of low pressure which usually stretches from Upper Sind to Chutia. Nagpur or Orissa. In it winds are, as might be expected, very variable, and the small cyclonic storms of the month which form in the Bay almost invariably advance almost this trough. The position of the trough will evidently depend upon the relative strengths of the two branches of the monsoon current. When the Bombay current is strong and the Bengal current weak (as has been the case during the past month), it will evidently be (as it were) thrust further north and occupy a position much nearer the hills than usual. The average position of the trough of low pressure is hence important as an indicator of the relative strengths of the two branches of the monsoon current.

Another very important feature of the meteorology of the month is the small cyclonic storms which form either in the Bay of Bengal or Bengal at brief intervals during the month. They usually advance in a west-north-west or west direction along the trough of low pressure. As they draw away the aqueous vapour from other districts and discharge it as rain over the districts they traverse, they tend to make the rainfall distribution of the month more irregular than it would otherwise be in Northern India. On the other hand, the general indraught causes a strong advance of humid winds for some days across the Bengal Coast. Hence they are always followed by more or less general rain over a large part of Northern India.

Barometric depressions and cyclonic storms of the month.—These were on the whole feebler and less frequent than is usual in July. There were in all three important depressions—the first land-formed, and the remaining two generated near the head of the Bay.

(1) *Land-formed storm of the 1st to 6th July.*—This was formed in Central Bengal on the evening of the 1st, and covered the Sonthal Pergunnahs and neighbouring districts on the morning of the 2nd. It marched westwards across Chutia Nagpur on the 3rd, the northern districts of the Central Provinces on the 4th, and through South Rajputana and Central India on the 5th, and filled up during the day. It gave a moderately heavy burst of rain to the districts through which it passed. For example, Hazaribagh received 3·74 inches on the 3rd and Jubbulpore 7·45 inches on the 4th.

(2) *Depression and cyclonic storm of 13th to 22nd July.*—A small depression began to form in the north-west angle of the Bay on the 12th. It remained almost unchanged in position and without developing further until the 17th. The barometer began to rise on the evening of the 17th, and the depression appeared to be filling up and moving westward on the 18th, on which day a very shallow depression extended from the Orissa Coast across the Central Provinces to Jubbulpore and Saugor. On the evening of the 18th the barometer fell rather rapidly in the north-west angle of the Bay, and a small but deepish depression lay between False Point and Saugor Island on the morning of the 19th. The storm centre crossed the coast early on the morning of the 20th between Saugor Island and Balasore, and passed rapidly across Chutia Nagpur during the day. The depression covered South Behar and the eastern districts of the North-Western Provinces on the 21st. It advanced very slowly to the north-west during the day, and filled up on the 22nd in the eastern districts of the North-Western Provinces. This storm gave a heavy burst of rain to Bengal, Chutia Nagpur, Behar, and the eastern districts of the North-Western Provinces. 9·55 inches were registered at Motihari on the 26th for the preceding twenty-four hours, and 9 inches at Pupri in the Muzaffarpur district on the 25th,

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Depression of the 27th to the 30th July.—This was a very shallow depression, which apparently formed at the head of the Bay on the 26th and drifted slowly across Chutia Nagpur and the north-eastern districts of the Central Provinces on the 28th and 29th. On the morning of the 30th it was in the eastern districts of the North-Western Provinces, and was then a diffused disturbance of slight importance. It filled up during the next twenty-four hours. This storm gave a moderate burst of rain to Orissa, Chutia Nagpur, and South Behar, and was immediately followed by very heavy rain in North Bengal on the 29th and 30th.

Pressure.—The chief barometric movements of the month occurred in connection with the storms described above. The following table gives the chief oscillations of the range of pressure or barometric differences between Southern and Upper India during the month, which are related to fluctuations in the general strength of the monsoon current blowing into India at this time :

Date.	Highest Pressure in Southern India or Ceylon.	Lowest Pressure in Upper India.	Range of Pressure or Total Gradient over India.
2nd	29·85	29·40	·45
4th	29·84	29·55	·29
7th	29·82	29·36	·46
12th	29·83	29·54	·29
19th	29·81	29·28	·53
22nd	29·81	29·43	·38
24th	29·83	29·24	·59
29th	29·80	29·50	·30

These figures show that the variations in the total gradient are almost entirely due to the oscillatory pressure changes in Upper India.

The mean pressure of the month for the whole of India was almost identical with the normal, differing only by +·004″.

The following table gives the barometric anomalies or local pressure variations in different parts of the country and those of the month of June for comparison :

Provinces.	Barometric Anomaly.	
	Month of June 1889.	Month of July 1889.
Burmah	+·011	+·004
Bengal	+·008	+·017
Assam	+·019	+·019
Behar and Chutia Nagpur	+·006	+·019
North-Western Provinces	+·003	+·015
Punjab	—·016	—·004
Sind and Rajputana	—·013	+·005
Central India	—·001	+·012
Central Provinces	—·004	+·005
Bombay	—·001	—·025
Madras	—·002	—·026

This table shows that the same general relation held in July between the anomalies in Northern and Southern India as in the preceding month. The most important change is the large increase in the negative anomalies of Bombay and Madras, directly related to the heavy rain in the Carnatic.

Temperature.—The temperature conditions were, as usual in July, mainly determined by the distribution of rainfall. The hottest parts of India were Upper Sind and the West Punjab and the southern districts of Madras, including Madura, Trichinopoly, and Tinnevelly. The fourth week of the month was the hottest in both these areas. The following gives the highest temperatures recorded during the month at stations in these areas :

Jacobabad	.. 116·1°	on the 24th.
Multan	.. 112·3°	„ 6th.
	.. 112·5°	„ 16th.

The variation of the mean temperature from the normal from week to week and for the whole month is shown for different districts in the different divisions :

Province.	Difference of Mean Temperature from Normal for Week ending July--				Difference of Mean Temperature from the Normal for the Month.
	8th.	15th.	22nd.	29th.	
Burmah	+1·2	+2·9	+1·6	+0·7	+1·6
Bengal	—0·2	+1·5	+2·1	—0·1	+0·8
North-Western Provinces	—0·8	—0·2	+1·8	+0·3	+0·4
Punjab	—0·5	—3·6	+0·7	+3·1	—0·1
Bombay	+1·0	+0·1	—0·1	+1·3	+0·6
Central Provinces and Berar	+1·4	+2·1	+1·5	+2·2	+1·9
Guzerat and Central India ..	—0·7	+0·6	+2·3	+1·4	+1·0
Sind and Rajputana	—1·1	+1·7	+3·4	+1·9	+1·6
Madras	+0·1	—0·4	—0·6	—0·1	—0·2

This table shows that the mean temperature of the month was considerably above the average in the Central Provinces and Berar (1·9°), Sind, Rajputana, and Burma (1·6°), in which districts the rainfall was below the normal. The variations in other districts were small.

Rain.—The month has been characterised by a smaller number of storms than usual and by the prevalence of a steady and strong monsoon, more especially on the West Coast. Hence the rainfall of the past month was more uniformly distributed than usual. During the first week of the month the rainfall was scattered in North-Western India and Madras, but was general in all other districts, and occurred almost daily in all districts. In the second week rain fell very steadily in Western and Central India due to the Bombay current. It also fell generally in Northern India until the 11th, when it was confined to Bengal and the North-Western Provinces. On the 14th it ceased almost entirely in Northern India and a partial break followed until the 20th, when a storm which had formed in the north-west angle of the Bay crossed the Coast and carried heavy general rain with it over Northern India.

During the last week of the month heavy rain fell over the whole of Northern India, except the Punjab. It was especially heavy in Bengal. On the other hand, the Bombay current fell off in strength and the rainfall diminished greatly in amount in Rajputana, Central India, the Central Provinces, as well as Western India and the Deccan. The rainfall of this period was unusually heavy in the hill districts, and more especially at Mussoorie and Naini Tal.

In consequence of the favorable conditions, the rainfall of the month was above the average over the greater part of India. The excess was generally moderate in amount. It was above the average over the whole of Northern India, including the Punjab, North-Western Provinces, Behar, North Bengal, Assam, and Orissa. The only area in which the excess was large was North Bengal, and this was chiefly due to the heavy rainfall of the fourth week of the month. There was a moderate deficiency in Lower Bengal, averaging 25 per cent of the normal.

The Western Coast districts and the Deccan and Carnatic have received normal or abundant rainfall. Mysore, Bellary, and the Carnatic obtained more than double the normal amount. There was a moderate excess in the Konkan and a large excess of nearly 30 per cent in Guzerat.

The rainfall of the month was in moderate deficiency in Sind, Cutch, Berar, and Khandeish, and largely in defect in the southern districts of the Central Provinces and in Rajputana and Central India. In these areas the deficiency ranged from 30 to 40 per cent. It was also about 20 per cent below the average in Lower Burmah.

Some heavy rainfalls were received during the storms described above, but as a rule excessive rainfalls have been quite the exception and have occurred much less frequently than is usual in July. In this respect the monsoon has had the same character as in the preceding month.

Strength of the monsoon currents.—So far as this can be judged by the strength of the winds at the coast stations, it would appear that both currents were above their normal strength. This is shown for the Bengal current by the following data :

Branch of Current.	Coast Stations.	Actual Average Daily Velocity, July 1889.	Normal Daily Velocity, July.	Variation in Wind Velocity, July 1889, from Normal.	Variations expressed as a percentage.
		Miles per day.	Miles per day.	Miles per day.	
Bay of Bengal ..	Akyab ..	120	105	+15	14 per cent excess.
	Chittagong ..	132	162	—30	19 per cent defect.
	Saugor Island .	408	406	+2	5 per cent excess.

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The following table gives complete data, and shows the actual average rainfall and the normal rainfall of the month of the twenty-one districts into which the country is divided, so far as it is indicated by the telegraphic reports of a few stations in each district :

Districts.	Number of Stations.	Normal Average Rainfall in June.	Actual Average Rainfall in June 1889.	Difference from the Average in June 1889.
Punjab, West	7	5·32	7·96	+ 2·64
„ East	4	10·45	12·02	+ 1·57
North-Western Provinces, Trans-Gangetic ..	7	14·83	18·68	+ 3·85
„ „ Cis-Gangetic.. ..	3	12·36	13·54	+ 1·18
Behar	2	5·86	9·80	+ 3·94
North Bengal	3	17·90	29·80	+11·90
Assam—Cachar	3	14·40	17·17	+ 2·77
Lower Bengal and Chutia Nagpur	8	13·07	10·38	— 2·69
Orissa—North Circars	5	8·84	9·60	+ 0·76
Central Provinces, South	7	18·35	13·15	— 5·20
Berar—Khandeish	2	10·94	9·13	— 1·81
Rajputana, Central India, Saugor and Nerbudda ..	9	12·71	7·59	— 5·12
Sind—Cutch	3	2·68	1·03	— 1·65
Guzerat	3	13·75	17·91	+ 4·16
Konkan	4	24·99	30·14	+ 5·15
Deccan—Hyderabad—	5	7·81	7·49	— 0·32
Malabar	5	33·90	29·90	— 4·00
Mysore—Bellary	4	3·30	6·38	+ 3·08
Carnatic	6	2·00	5·48	+ 3·48
Lower Burmah..	7	28·21	21·47	— 6·74
Ceylon	1	6·40	7·36	+ 0·96

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